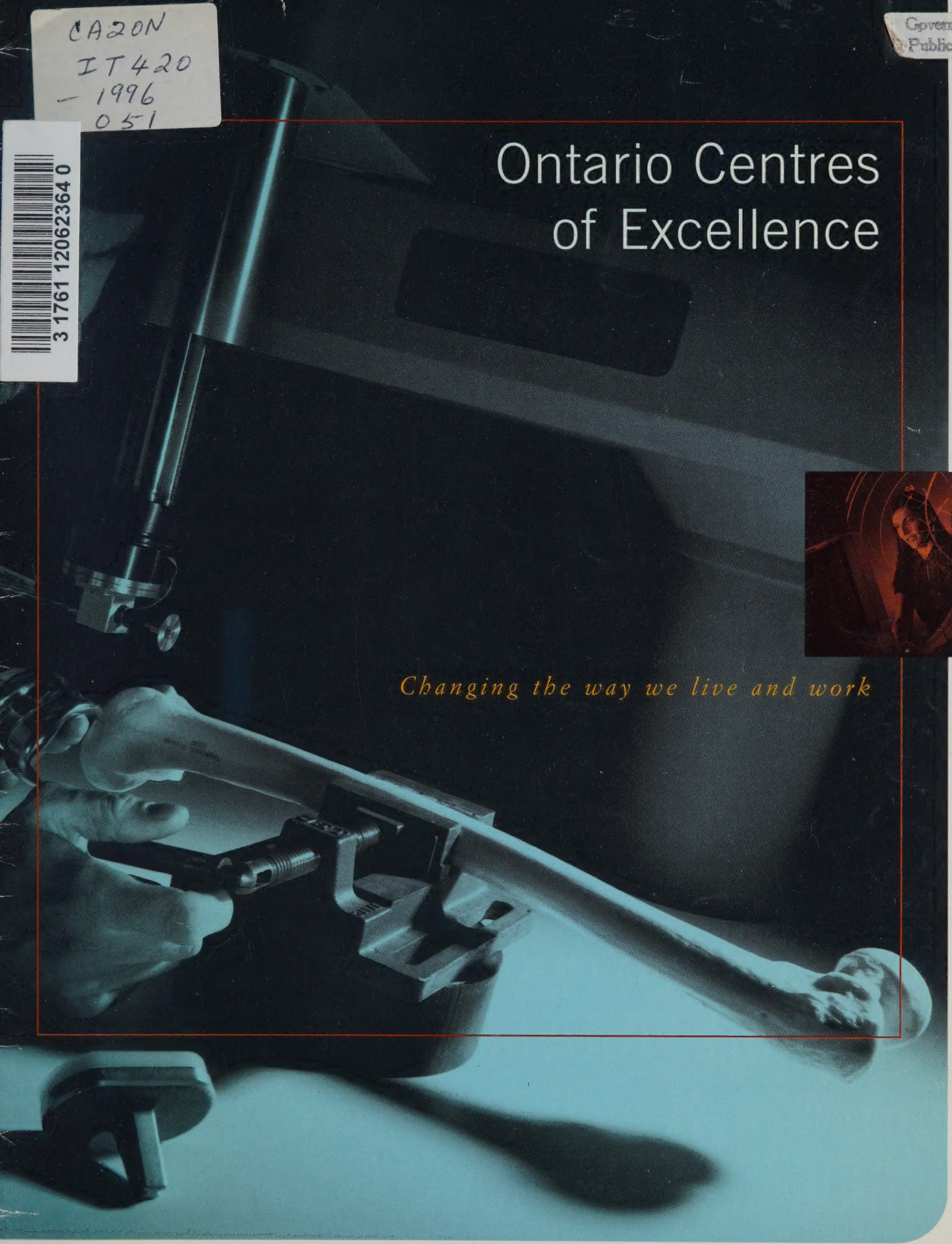
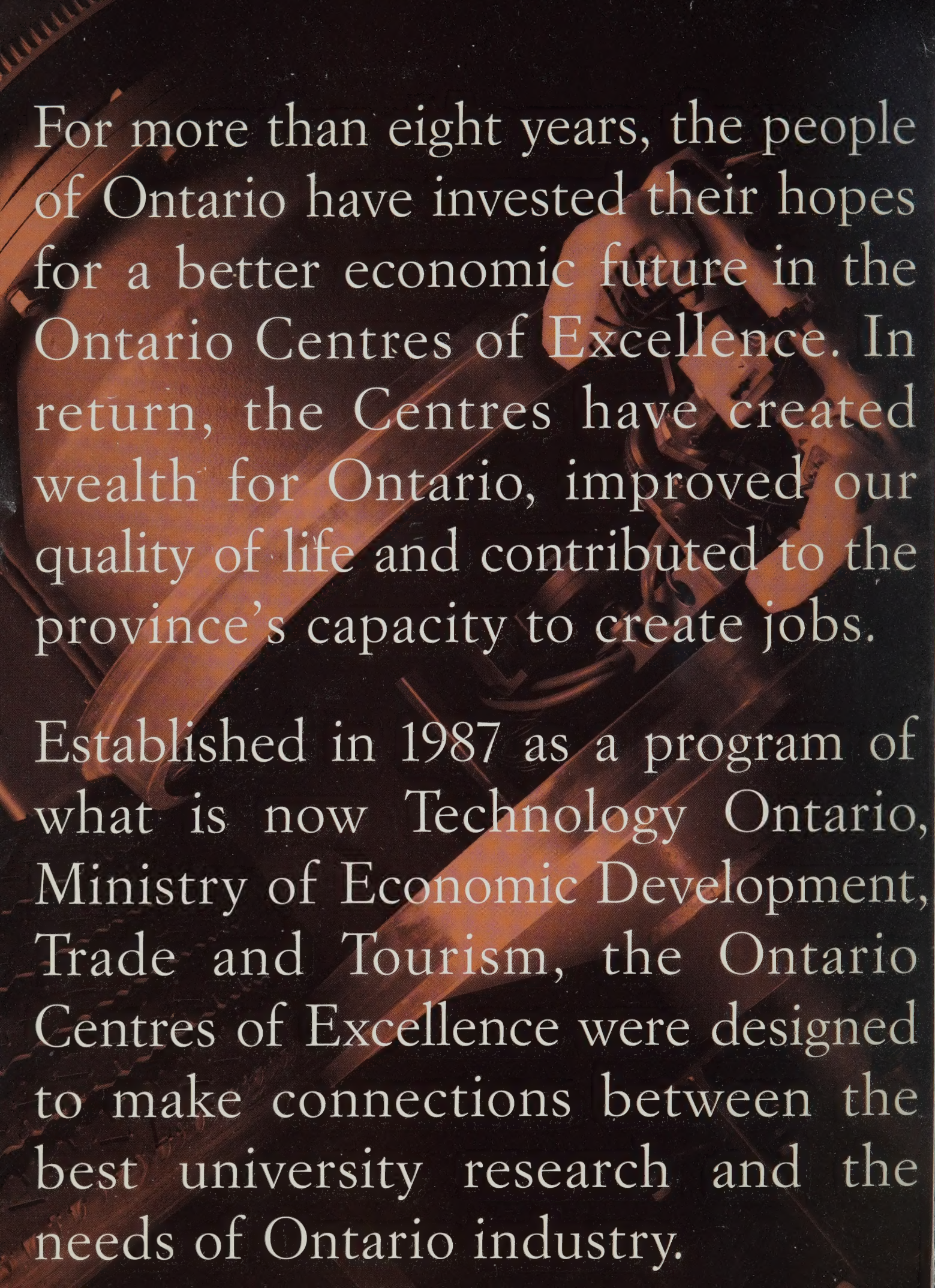


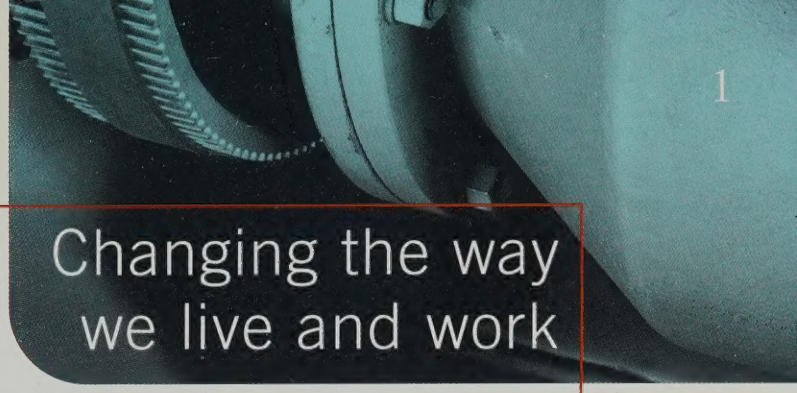
Ontario Centres of Excellence

Changing the way we live and work



For more than eight years, the people of Ontario have invested their hopes for a better economic future in the Ontario Centres of Excellence. In return, the Centres have created wealth for Ontario, improved our quality of life and contributed to the province's capacity to create jobs.

Established in 1987 as a program of what is now Technology Ontario, Ministry of Economic Development, Trade and Tourism, the Ontario Centres of Excellence were designed to make connections between the best university research and the needs of Ontario industry.



Changing the way we live and work

Valuable and potentially exploitable resources of our universities – new knowledge, technology and people – needed to find their way to market.

More, it was clear that business and industry would profit from turning to universities with problems or opportunities.

Finally, our highly trained graduates in science and engineering presented the province with challenges: many were leaving the province for jobs elsewhere; many were unschooled in the real-life problems of industry; and many didn't know how to take their research to market – how to be entrepreneurs. As well, the province needed more science and engineering students trained in advanced science and technology.

Through a rich mix of initiatives, from the creation of consortia to mentoring graduate students, Ontario's seven Centres of Excellence have tackled these issues. In doing so, they have had an impact on our health and environment, on the training and education of our university students and on the success of new businesses and existing industries.

Not least, because the Ontario Centres of Excellence accomplish all of their work with partners, the Centres are also having a positive impact on the culture of our universities, business and industry. In universities, the Centres are helping to create a new entrepreneurial spirit. Businesses, taking note of Centres' consortia success stories, are learning to work together for competitive advantage in world markets.

Each of the seven Centres of Excellence employs programs and funding mechanisms to achieve one shared goal – the economic development of Ontario. For example, funds provided to university researchers are not merely grants to further important work, but, rather, an investment, made and monitored by the Centres of Excellence on behalf of the people of Ontario – an investment in our collective economic and social well-being. When the Centres of Excellence fund research they are not subsidizing universities or businesses – they are investing for concrete return-on-the-dollar to Ontario.

The results so far are impressive.

To begin, the Centres of Excellence work with more than 1,000 companies in Ontario, from our largest industrial companies to progressive small and medium-sized companies emerging as important contributors to our economic future. There have been 355 patents and 252 licenses issued to date. More than 1,200 students have gone to work in Ontario industry.

Through the work of the Waterloo Centre for Groundwater Research, a pollution testing device – called one of the 100 most brilliant inventions of the year – was created. And startling new knowledge about the difference between male and female fetal distress signals has been applied around the world, profoundly changing the way fetal monitoring is interpreted. This work is a spin-off of telecommunications research conducted through the Telecommunications Research Institute of Ontario.

A radio astronomy project of the Institute for Space and Terrestrial Science has led to the commercialization of mass data storage technology expected to generate hundreds of millions of dollars in sales. New fingerprint technology, resulting from an Ontario Laser and Lightwave Research Centre partnership, has the potential to dramatically reduce credit card and other fraud. And a company created as a result of Information Technology Research Centre work is marketing software that will turn ordinary computer networks into virtual high performance computer facilities.

Among the most significant achievements are the secured futures of Ontario science and engineering students. As one former Waterloo Centre for Groundwater Research student, Mark Trudell – now a full time researcher – put it, "My education…helped me see the connection between scientific research, technology development and commercial applications." Another, Ed Panziera, formerly a Manufacturing Research Corporation of Ontario Connections student, says his "training ultimately secured full-time employment for me."

The Ontario Centres of Excellence created the Martin Walmsley Fellowship for Technological Entrepreneurship, which gives talented young researchers the chance to commercialize their work in Ontario. The first award was made to two Ontario Centre for Materials Research students whose novel ceramic coating process is being marketed by their own new company.

Other young entrepreneurs have learned everything from how to write a business plan to how to protect their innovations through the Centres' Mentortech lecture program.

The stories of these initiatives and many others are described in the next few pages. If you wish to know more about the Ontario Centres of Excellence, collectively or individually, turn to the back cover for information about how to get in touch. The Ontario Centres of Excellence can make you a partner in changing the way we live and work in Ontario… for the better.

New business

At the heart of Ontario Centres of Excellence work is the creation of new business – new products for existing companies, large and small, and brand new enterprises. Through the Centres, knowledge, technology and skilled people are transferred from the university research community, creating jobs and wealth for Ontario. Not least among these new businesses are those created by researchers themselves, helping to develop within our universities a new entrepreneurial spirit. Along with other Centres-supported new business, they're putting university resources to work for economic development.

Mass data storage one legacy of radio astronomy research

The S2 Very Long Baseline Interferometry system developed in the Space Geodynamics Laboratory at the Institute for Space and Terrestrial Science (ISTS) to support radio astronomy research is now accepted internationally as a de facto standard in this field. Sales to users in five countries have topped $24 million. A spin-off from the S2 system is the NearLine Mass Data Storage System. It is this technology that has been transferred to a publicly traded company (Legacy Storage Systems International Inc., Markham, Ontario) for commercialization. This mass data storage technology has the potential to generate "hundreds of millions of dollars in sales for Legacy," according to Legacy president David Killins. ISTS's equity position with this company is a first for an Ontario Centre of Excellence. Licensing, royalty and follow-on R&D agreements have also been concluded with all partners.

Graduate students take research to market

Two graduate students who developed a process for coating objects with thick ceramic film are now principals in DATEC Corporation, a company they formed to market the novel technology. The process is considered to have significant export potential. The original research, supported by the Ontario Centre for Materials Research (OCMR), won Queen's University graduate students, David Barrow and Ted Petroff, the Martin Walmsley Fellowship for Technological Entrepreneurship.

'Single chip' cell phone will cut costs

An important new technology spearheaded by the Telecommunications Research Institute of Ontario (TRIO) and developed by researchers at Carleton University's Department of Electronics, as well as specialists at Northern Telecom, Nepean, Ontario, may have an impact in excess of $1 billion US on mobile and personal communication product sales. The Fractional N Frequency Synthesizer allows controllable and accurate synthesis of frequencies up to 2 Ghz in low power products. This means it is now possible to produce a single chip cellular telephone, theoretically as small as a credit card, and could reduce costs substantially. The technology is patented and licensing is being completed.

Fast growth firm markets intelligent technologies

Virtek Vision Corporation, a spin-off company of the University of Waterloo Department of Systems Design Engineering PAMI (Pattern Analysis and Machine Intelligence) Laboratory, is becoming an important player in intelligent image systems. With support from the Manufacturing Research Corporation of Ontario (MRCO) in transferring the technology, the company produces machines that can recognize shapes and patterns, and take action. Virtek has successfully marketed intelligent processing technologies in aircraft manufacturing, roof truss construction, leather and furniture product cutting, and visual inspection of car panels and bottles. It is the fifth-fastest growing company in Canada, according to Profit magazine.

Space technology improves surfaces on earth

Two new methods of modifying polymer (plastic) surfaces, developed by Integrity Testing Laboratory Inc., at the University of Toronto's Institute for Aerospace Studies, are attracting tremendous interest from industry and government agencies. One process improves resistance to oxidation, weathering, chemicals and moisture; the other allows tailoring of mechanical, optical and electrical surface properties, among other advantages. Both processes were originally developed to counter the negative effects of atomic oxygen and ultraviolet light on materials in low earth orbit but have been found to be inexpensive and appropriate for materials used on earth. The work was supported with funding from the Institute for Space and Terrestrial Science (ISTS) and the Ontario Centre for Materials Research (OCMR).

Telepresence: Virtual visits to distant colleagues

At least three industrial partners participating in the Ontario Telepresence Project will or have commercialized products based, in part, on insights gained through their involvement. Sponsored by the Information Technology Research Centre (ITRC) and the Telecommunications Research Institute of Ontario (TRIO), the project examined the 'human dimension' in interactive video conferencing. Specifically, researchers worked with a set of computer, audio-video and telecommunications technologies, known as Telepresence, which gives users the feeling of being present in each other's workplaces. Using multiple cameras and 'surrogate' images, among other techniques, it goes beyond traditional 'talking head' video conferencing by allowing participants to view each other's surroundings and communicate with others besides the main speaker. It also makes possible more subtle forms of communication (such as non-verbal cues about a person's approachability at a particular moment). Corel Corporation, Ottawa, Ontario, is predicting that its CorelVIDEO product, based heavily on refinements to Telepresence, will rival the success of its graphics software package, CorelDRAW, which propelled the company into the top 10 business application software companies in the world in 1994.

Computer software shares the load

'Load Sharing' software developed by the Computer Science Department at the University of Toronto and funded in its early stages by the Information Technology Research Centre (ITRC), has led to the formation of a spin-off company, Platform Computing Ltd., which is projecting revenues this year of several million dollars. The program enables a set of UNIX workstations, connected by a local area network, to be used together very efficiently to support computer aided design and other applications, effectively turning the network into a "virtual high performance computer facility" (without the purchase of a high end computing system).

a case history

Waterloo Centre for Groundwater Research

Supelco's MicroExtraction revolutionizes environmental sampling

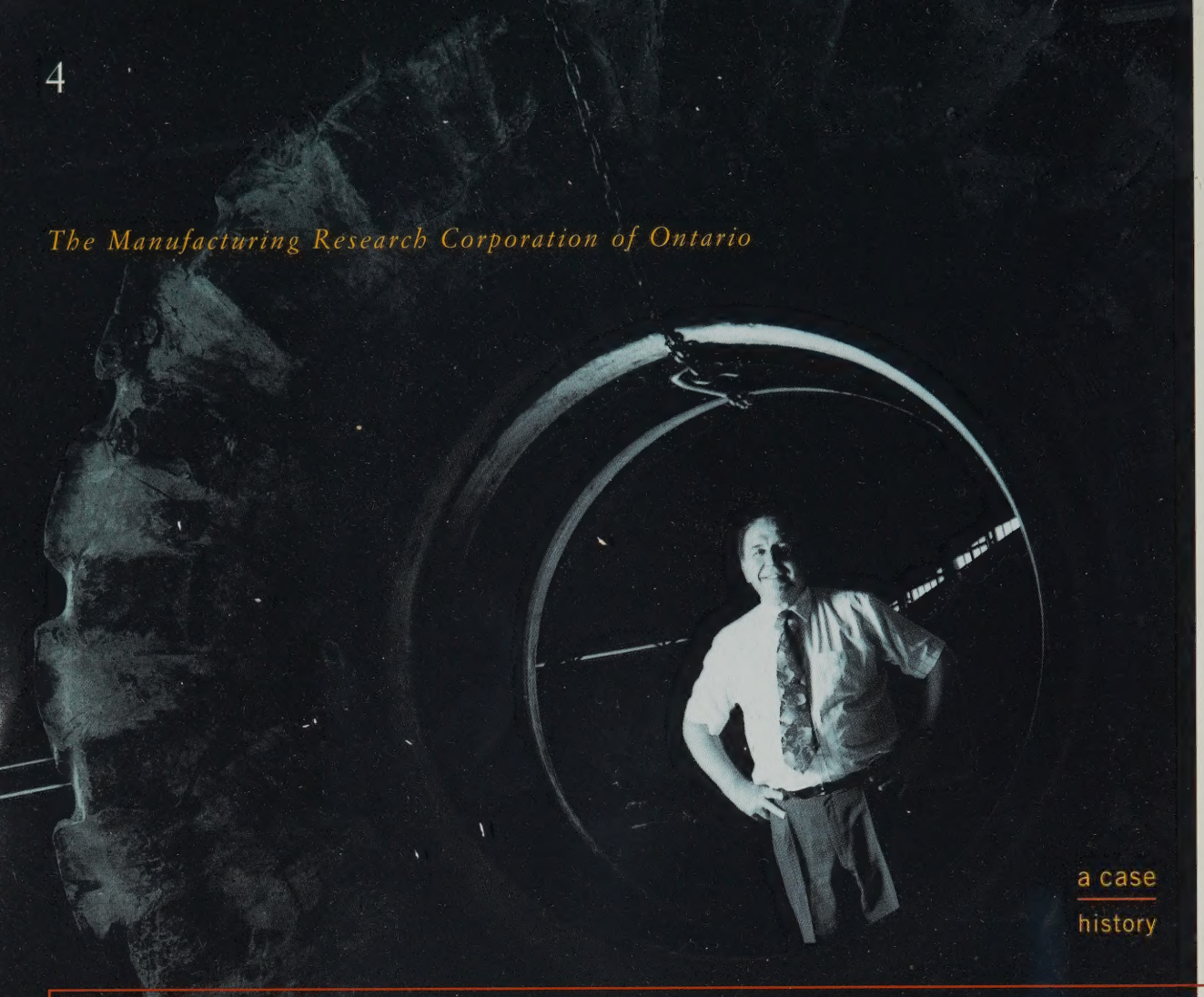
Traditional methods for testing chemical pollutants in water samples are laborious, time-consuming and expensive. Even worse, they use toxic solvents to extract the chemicals being tested, thereby adding to environmental contamination.

Now, an elegant new method developed by Dr. Janusz Pawliszyn is promising to change all that. Solid Phase MicroExtraction (SPME) is already available commercially for a variety of chemicals from PCBs and pesticides to caffeine and alcohols. The original work was partially supported by the Waterloo Centre for Groundwater Research (WCGR) at the University of Waterloo. Applications research is ongoing with continuing support from WCGR. Scientists at the University of Guelph are also evaluating the method for use in remote locations. The technology has been licensed to Supelco Canada Ltd., Mississauga, Ontario, which is producing the apparatus.

This new approach to sample preparation does not require the collection and transportation of large water samples – a major advantage because of transportation and handling costs as well as potential breakage. More, it does not use solvents to extract the material being tested. It uses an extraction instrument resembling a syringe and containing a specially coated glass fibre. When immersed in water, the fibre adsorbs specific chemicals for later analysis and quantification. The fibre is pulled back inside the syringe and is then ready for testing. "This fibre goes right into the analytical instrument, the chemicals are desorbed and you get a very rapid turnaround," says Dr. Dennis Gregor, WCGR manager. The method is also being used for testing air, soil and food samples.

Last year R & D Magazine, published by The American Science Journal, named the device one of the world's 100 most brilliant inventions of the preceding year. Still, there are hurdles to be crossed. One is regulatory approval. Much environmental testing is done for legal purposes and the test methods used must be evaluated and approved by regulatory agencies. Another is adapting laboratory autoanalysers to be compatible with SPME. Varian Canada Inc., Georgetown, Ontario, is working to adapt its laboratory instruments for SPME and to perfect rapid automated testing.

Currently Supelco offers five different versions of the SPME fibre, and approximately 100 laboratories in Canada are using them. The technique is attracting global attention. Planned research will apply the technology to on-site analysis, thereby avoiding the need to transport the test syringes back to a lab.



a case history

Robot rejects truck tires unsuitable for retreading

Retreading truck tires is big business in North America – and even bigger in other parts of the world. Each year on this continent, 17 million truck tires are refurbished. But despite best efforts to distinguish those worth saving from those unsuitable for retreading, mistakes are made in about 10 per cent of cases. That means the tire is retreaded but blows shortly thereafter, or, conversely, ends up in a dumpsite unnecessarily.

The average cost of retreading a truck tire is $200, but can be much higher in the case of specialized vehicles, such as those used in mining. Each year $340 million is wasted on futile retreading in North America alone. Obviously, a more accurate method of assessing tires for defects prior to retreading could save costs for truck owners.

Enter Vulcan-Vulcap Industries Ltd., of Scarborough, Ontario. Using ultrasound technology, its Ultrasonic Tire Casing Analyzer provides a non-destructive method of inspecting tires and tire casings. The analyser helps the operator decide whether a tire can be retreaded or must be discarded. Unfortunately, the task is laborious and somewhat subjective.

In an effort to simplify the process, a collaborative research project is now underway involving Vulcan Engineering Services Inc. (a spin-off company of the University of Toronto), and the Manufacturing Research Corporation of Ontario (MRCO).

Researchers led by Professor Andrew Goldenberg are developing an 'Intelligent Controller' based on robotic end-effector technology that will make the casing analyzer easier and more accurate to use. It will regulate the sensing operation, provide autonomous positioning, and fine-tune sonic parameters so defects can be detected and evaluated reliably. The size of flaws to be rejected is pre-programmed, and a print-out of the tire condition is provided automatically. Developers are confident the new controller will simplify the analysis of any tire regardless of tread depth, design or wear pattern.

"Ultimately, this product will provide the retreading industry with a strong competitive advantage," explained Vulcan owner and president, Heinz Haischt. "As a result, Vulcan expects to substantially increase sales worldwide and create employment opportunities."

Support for Ontario industry

For many companies, the only way to remain strong and competitive in the international marketplace is through continual innovation and improvement of their products. Standing still is not an option for survival. Although in the past companies may have felt the academic community was unapproachable, today, through the efforts of the Ontario Centres of Excellence, many Ontario companies are tapping into university researchers for help in solving problems or developing the next generation of products. More, well-trained students with 'intrepreneurial' skills move through Ontario Centres of Excellence programs and into Ontario industry. Finally, networking opportunities afforded by the Centres have shown many companies, big and small, that collaborative projects can be very rewarding.

Smoke, fire and steam created by computer

Software used to create computer animation of turbulent gases, including smoke, fire and steam, has now been licensed to Alias Research Inc., a company supplying animation tools to the entertainment industry. The technology, renamed Alias Particles, has been incorporated into the company's recent successful software products. The original work, part of the Dynamics Graphics Project in the Department of Computer Graphics at the University of Toronto, was supported by the Information Technology Research Centre (ITRC).

OCMR links First Brands to university researchers

Thanks to networking opportunities created by the Ontario Centre for Materials Research (OCMR), as well as funding support from the Centre, a study conducted by the University of Toronto's Department of Chemistry has resulted in a first-time link for First Brands (Canada) Corporation, Orangeville, Ontario, with university-based researchers. First Brands manufactures polyethylene products such as freezer and cling wrap for the consumer market. The project studied factors affecting optical clarity in the manufacture of polyethylene film, and identified critical factors for improved process control.

Partners plan an even better big screen

A partnership between Imax Corporation and the Ontario Laser and Lightwave Research Centre (OLLRC) will lead to a better understanding of the polarization properties of screen surfaces used in IMAX® theatres, and ultimately, to development of a model to guide the search for better screen materials. Such a model could also be used to predict screen performance given the geometry of a specific theatre. In addition, the partners will try to improve upon conventional methods of producing 3-D images, using alternating eyeglasses (shifting from left to right). Such advances will help Imax maintain its world leadership position in large screen systems. IMAX is a registered trademark of Imax Corporation.

Collaborative research program cuts manufacturer's costs

Reko International Inc., Windsor, Ontario, makers of injection moulds and other industrial tools, has tapped into new technologies and university researchers to make itself more competitive. The company has embraced the CAD/CAM philosophy (improvements through computer-aided design and computer-aided manufacturing) to cut down on machining time and cost. The company is using planning module technology for CAD/CAM systems developed jointly by Reko and the University of Waterloo's Department of Industrial Engineering. Development of the technology is a direct result of the Manufacturing Research Corporation of Ontario (MRCO) Collaborative Research Program.

Computers will predict when it's time to change the oil

Work being done by the Manufacturing Research Corporation of Ontario (MRCO) Condition-Based Maintenance Consortium will develop theoretical modeling and computer software to help industries better judge when industrial machinery and vehicles require maintenance servicing. Deliverables on this project, which involves several corporate partners (ALCOA, Barrick Goldstrike Mines, Dofasco Inc., Molson Breweries, Oliver Interactive, Syncrude and Wear Check Canada) and University of Toronto researchers, are eagerly anticipated by industry, and expected to reduce maintenance costs.

Lost software designs recovered

A problem for organizations using large 'legacy' computer systems (typically banks, airlines and data processing departments in many businesses) is the fact that the systems have been maintained and modified so many times over the years that the original software designs have been lost. Recovering these designs is critical if the software is to move forward. A rescuer is on the horizon in the form of TXL Pro, a software system that enables automatic software transformation among software system designs, databases and actual software code. The Information Technology Research Centre (ITRC) supported the work, also providing assistance in licensing the technology. TXL Pro is now being exploited by Kingston, Ontario-based Legasys Corp. and sublicensed to Design Recovery Inc., Toronto, Ontario.

Headlamp research keeps company out in front

Autosystems Manufacturing Inc., Belleville, Ontario, is a supplier of state-of-the-art composite headlamps to both domestic and foreign automobile manufacturers. As part of their ongoing commitment to quality improvement, they sought to understand the source of occasional surface imperfections appearing in headlamp reflectors. The Ontario Centre for Materials Research (OCMR) helped Autosystems assemble a team of researchers, including chemists from the University of Toronto and physicists from Queen's University. With funding support from both the OCMR and Autosystems, the team successfully identified the cause of the problem, helping Autosystems maintain its leadership position in the industry.

Plastics breakthrough builds better biomaterials

a case history

Biocompatability is a critical feature when developing synthetic materials for use inside the human body. But materials chosen for particular properties, such as strength and flexibility, may have other characteristics that make them less than desirable for medical applications.

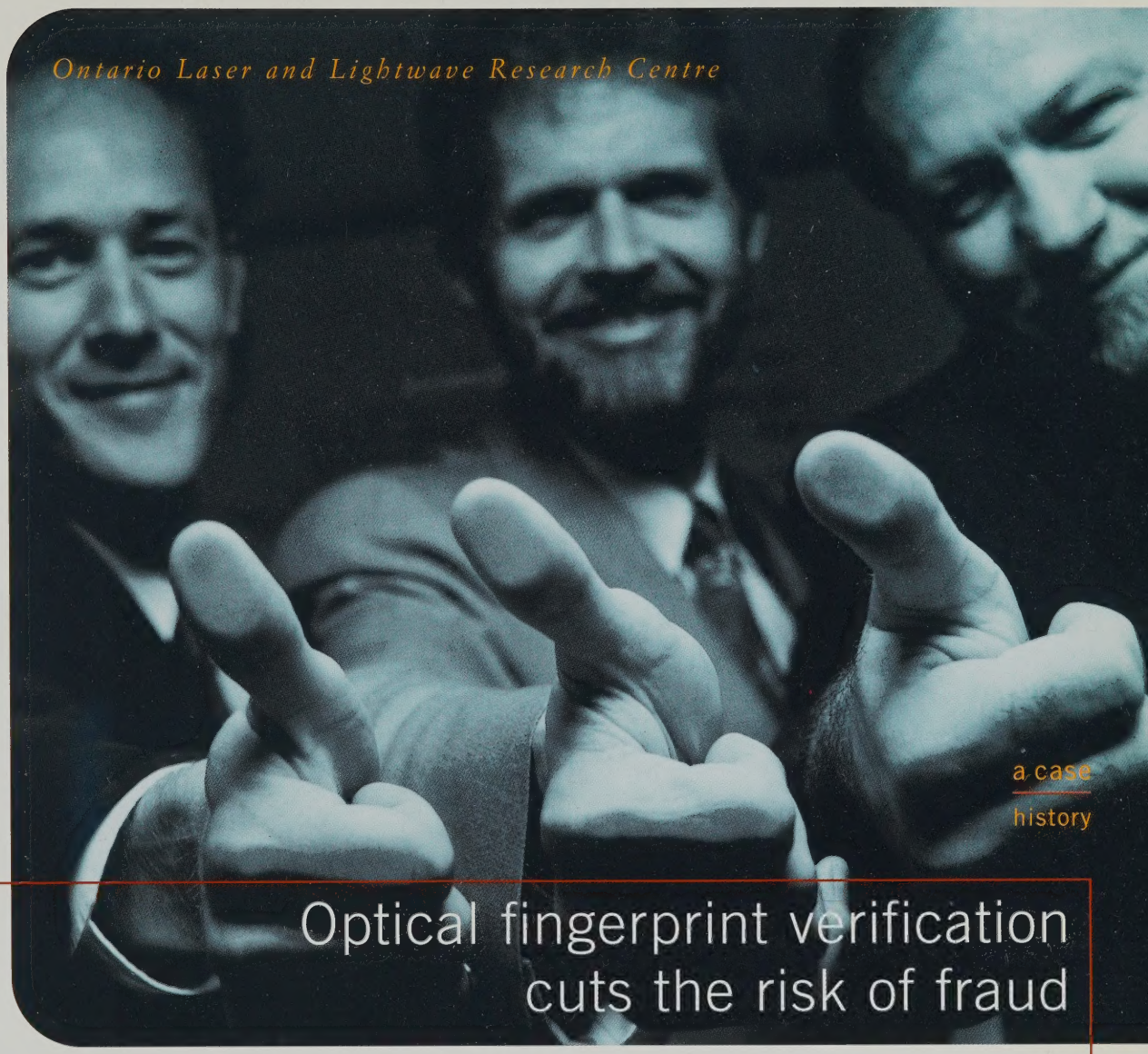
Such is the case with plastics used in various catheters. While possessing excellent physical properties, these plastic materials can show a tendency for bacteria to adhere to the surface, increasing the risk of infection.

Now, research supported by the Ontario Centre for Materials Research (OCMR) has led to the discovery of a process to modify the surface of plastics by applying special additives called surface modifying macromolecules. The result is a material that is expected to show greater resistance to bacterial buildup, and which also exhibits greater lubricity and wetability – desirable qualities for certain medical procedures.

Originally, OCMR funded this work, conducted by Dr. Paul Santerre at the Universities of Ottawa and Toronto, because of its clear general utility in the biomaterials area. Then, at an annual networking meeting, organized by the OCMR, representatives of Vas-Cath Incorporated, Mississauga, Ontario, (makers of sophisticated catheters used in cardiac and other medical procedures) met Dr. Santerre and immediately recognized the potential of the technology for their products. The rest, as they say, is history and OCMR expects to negotiate a licensing agreement with Vas-Cath in the near future.

To further the work, the Centre is collaborating with Vas-Cath in a jointly funded research project to look at the practicalities of applying this new technology in a production environment. "This could be a real breakthrough," said Attilio DiFiore, bioengineering supervisor at Vas-Cath. "It will give the company a unique technology that will help maintain its leading edge in a globally competitive business that requires continual innovation."

Ontario Centre for Materials Research



a case history

Optical fingerprint verification cuts the risk of fraud

Every year, Canadian businesses and government agencies lose hundreds of millions of dollars due to credit card, welfare and immigration fraud.

The Canadian Bankers' Association put the banks' loss at $73 million in 1993-94 with more than 55,000 cases of credit card fraud reported. In Ontario, the Ministry of Community and Social Services along with municipalities referred 1,029 cases of suspected welfare fraud to local police during a five-month period in 1994. And the Ministry of Health estimates losses of $65 million in health card fraud. To combat the problem of soaring costs associated with fraud and misuse, a system of positive identification is vital.

Seeing the need and anticipating a large and growing potential market, Mytec Technologies Inc., North York, Ontario, launched the world's only optically-based fingerprint verification system, known as Zebra True Recognition™ in April, 1995. Dr. George Tomko, president and CEO of Mytec, came up with the idea in 1990 and approached the Ontario Laser and Lightwave Research Centre (OLLRC) for help in developing it.

Mytec provided the marketing expertise, engineering talent and financing, while OLLRC contributed scientific expertise and facilities for optical processing technology. Initially, a feasibility study was completed, and then an engineering prototype built. Patents have now been secured, and in mid-1994, the project was transferred to Mytec labs. Mytec has hired 13 scientists to work on continuing development of the project.

Zebra True Recognition is a computer-based system that converts a person's fingerprint into a biometric encryption (optical pattern) stored within the system. There is no retention of the fingerprint itself, however, ensuring that fingerprints cannot be shared or accessed for unintended uses. The system could be used to verify that a person presenting a health card is indeed the proper holder of the card. Or it could be used to verify passport holders and credit card users. A positive identification can be made in four nanoseconds.

The technology also permits access to up to 24 million bits of information stored on a smart card – a person's medical history, including x-rays and medication record, for example. Other potential applications include biohazard control and blood labeling. It would also be possible to reduce the size of the optical scanner and install the technology in 200,000 pay phones across Canada. "The size of the market boggles the mind and interest in the technology is expanding every year," said Dr. Tomko.

Environment

More and more often, solving or preventing environmental problems creates business opportunities and results in the formation of new enterprises in Ontario. This is a win-win situation – one which is enabled by the Ontario Centres of Excellence. Historically, much environmental research has focused on identifying environmental problems and finding ways to monitor them. In working with researchers and corporate partners, the Centres are constantly trying to move these efforts further forward – not only identifying problems but finding cost-effective and practical solutions which are then commercialized for the benefit of the economy and the environment. As well, co-operative research between public sector agencies, responsible for environmental resource management, and the Ontario Centres of Excellence is providing evaluation techniques and developing effective protection strategies.

Waterloo Barrier contains contaminants

An inground barrier used to control the migration of subsurface pollutants has spawned a new company, Waterloo Barrier Inc., Rockwood, Ontario, and will increase sales for two existing Ontario companies. Canadian Metal Rolling Mills of Cambridge, Ontario, is the licensed manufacturer for North America of unique steel sheet piling with specially designed joints that can be sealed once the sheets are in the ground. C3 Environmental, Breslau, Ontario, is a licensed installer. Once the joints are sealed, the barrier prevents off-site migration of contaminants. Recent applications in Canada have controlled methane gas generated from closed landfill sites and protected an industrial site from contaminants in adjacent properties. The barrier was developed by the University of Waterloo Department of Earth Sciences, with support from the Waterloo Centre for Groundwater Research (WCGR).

Process treats toxic organics in groundwater

Envirometal Technologies Inc., Guelph, Ontario, established in 1992 to commercialize technology developed through the Waterloo Centre for Groundwater Research (WCGR) at the University of Waterloo, is now evaluating clean-up technology in more than 125 sites. The cost-effective technology uses a reactive metal to break down dissolved toxic molecules in groundwater. It is a passive process requiring no pumping or other ongoing energy inputs, and contaminants are degraded in-situ, not transferred from one medium to another.

Lasers make filters for 'plastic soup'

Recycling of plastics involves filtering a 'plastic soup' to remove contaminants. Unfortunately, the filters tend to clog up and are costly to replace – coming as they do from Germany. Soon, however, clean-up of used filters and production of new ones may be possible right here in Ontario. A collaboration between Resource Plastics Inc., Brantford, Ontario, and The Laser Machining Centre Inc., initiated by the Ontario Centre for Materials Research (OCMR), is developing a novel drilling technique using copper vapour lasers to create the tiny ('hairsbreadth') pores needed in the filters. Eventually it may also be possible to clean used filters using advanced cleaning technology – expected to lead to a new industry and reduced recycling costs.

Project studies how plants can help man in space

A project studying closed-cycle environmental systems, involving several corporate partners and facilitated by the Institute for Space and Terrestrial Science (ISTS), promises a number of spin-offs expected to both benefit Ontario's greenhouse industry and train highly qualified personnel as potential mission specialists for space flight. Researchers will evaluate the contribution of a variety of plant species to human life support in a sealed environment. The ongoing work is expected to lead to practical applications in manned extraterrestrial living and working environments, indoor air quality ('sick building syndrome') and water analysis.

Grand River Project unlocks information

The Grand River Watershed ECO-Research Project studies the effects of urbanization on a watershed, examining water supply, water quality, and socioeconomic issues including governance and information systems. Parts of the project will generate information and computer software designed to prevent information 'gridlock' in watershed studies. Researchers will also validate methods for evaluating watershed management policies. The project involves nine University of Waterloo co-investigators with colleagues in three universities as well as liaisons with the private sector and several governments with jurisdiction in the Grand River Watershed. The Waterloo Centre for Groundwater Research will act as a technical advisor.

Picture this: a lush tropical rain forest complete with orchids, frogs, and more than 400 species of plant life, rising from floor to ceiling around your corporate boardroom. It sounds like a little bit of heaven, but at Canada Life Assurance Company in Toronto, Ontario, it is reality. All are part of an experiment studying plants as 'air cleaning machines,' and assessing the ability of a natural ecosystem to improve indoor air quality.

The project is a collaboration between Genetron Systems Inc., Downsview, Ontario, creators of the 'breathing wall' that lies at the heart of this unique ecosystem; Lander Control Systems Inc., Guelph, Ontario, responsible for the technology used in monitoring and measuring various air quality parameters; and a research group at the University of Guelph.

The original work to create the 'breathing wall' – a porous substrate of lava rock on which the plants grow – has already resulted in a number of patents, and potential clients are lining up pending results of the Canada Life experiment. Direct and indirect benefits are expected to be enormous. The research will help place Canada on an equal footing with Japan, the U.S. and Russia in Controlled Environment Systems (CES) technology, and will allow us to identify niche markets for product development in control systems, sensor technology and environment algorithms for CES.

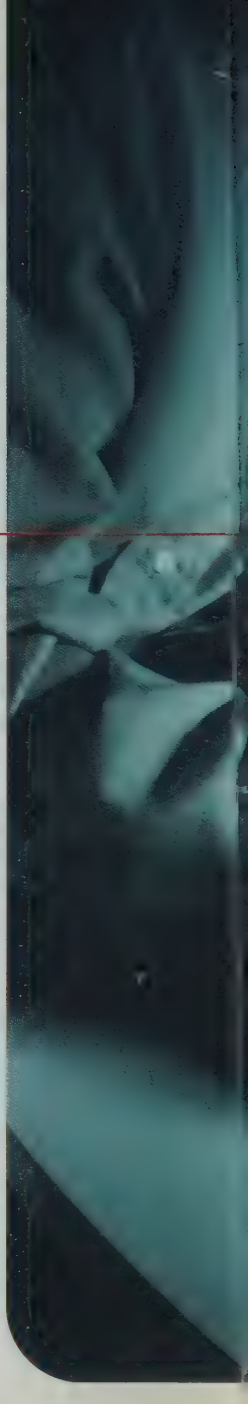
The Genetron system is unusual in that it uses no soil but relies solely on water (initially) allowing the plant and animal species (fish and insects) to achieve their own natural equilibrium – and eventually their own soil. No nutrients or fertilizers are added, and in time the system becomes self-sustaining. A negative pressure draws room air through the porous breathing wall where it is cleansed by the continuous flow of recirculated water over and through the lava rock. The resulting air is cleaned so thoroughly that the air inside a building is cleaner than the air outside.

"Variations on this theme can and will be applied to a wide range of indoor air quality problems," predicts project leader, Dr. Mike Dixon of the University of Guelph. "There's no reason [air-cleansing ecosystems] can't be routinely factored into the architectural design of buildings."

The project, which establishes a permanent research facility at the Canada Life site, is a direct spin-off of a research program sponsored by the Institute for Space and Terrestrial Science (ISTS) and the University of Guelph and the Natural Sciences and Engineering Research Council to study life support systems in hostile extraterrestrial environments.

Health

Healthy, Wealthy and Wise. Three laudable goals for people and for communities – all goals the Ontario Centres of Excellence are helping Ontario achieve. In the health care sector, the Centres are bringing industry partners and university researchers together to achieve important medical technologies that will save lives and improve quality of life. They are also fostering research that will result in more cost-effective health care. In the process, the Centres are nurturing a home-grown health industry by helping fledgling Ontario companies find their footing as they stake out niche world markets.



Spin-off research improves fetal monitoring

A project to improve telecommunications diagnosis has had a surprising medical benefit. Spin-off research to improve fetal monitoring, undertaken by a team of computer engineers at Carleton University and obstetricians at Oxford University, has made a significant medical finding.

The work, supported by the Telecommunications Research Institute of Ontario (TRIO), discovered unexpected and fundamental differences in the signals given out by distressed male and female fetuses – a finding that is expected to lead to significant improvements in the assessment of fetal distress. Several Canadian companies have taken notice, and one, a TRIO partner, is ready to upgrade its fetal monitoring systems to incorporate the new Automated Discovery of Diagnostic Symptoms (ADDS) diagnostic system.

ADDS uses standard non-invasive measures taken during labour, including ultrasound readings of fetal heart rate, to assess fetal distress. Its original development for use in communications fault diagnosis was assisted by several TRIO member companies who provided practical information about the monitoring of networks.

'Invisible' cancers detected

A strategic partnership between the Ontario Laser and Lightwave Research Centre (OLLRC), The Wellesley Hospital, the Ontario Cancer Institute/Princess Margaret Hospital (OCI/PMH) and corporate partners, Xillix Technologies Corporation and Olympus Optical Company, promises to deliver a breakthrough technology for detecting early gastrointestinal (GI) cancers.

The innovative light-based technology will make it possible to detect GI tumours when they are only a few cells deep and invisible to the human eye. This means treatment can begin while the tumour is localized and still curable. The project is the first for the newly established Biomedical Satellite Facility, run jointly by OLLRC and OCI/PMH, whose mandate is to strengthen research in photobiology, photophysics, photo-medicine, and biomedical optical instrumentation.

Software creates reports – and new business

Accurate and timely medical reports are key to quality health care in hospitals. Yet, filling out forms and interpreting reports, storing them and finding the information is time-consuming and error-prone. To streamline the process, University of Waterloo and University of Toronto computer science researchers, Chi Systems Inc., Chedoke-McMaster Hospital and a German research centre, in collaboration with the Information Technology Research Centre (ITRC), are undertaking a three-year research project. The software developed will allow hospitals to create a general knowledge base on each patient's condition and generate reports tailored to the needs of each medical specialty. The work is expected to open world market opportunities for Ontario software and systems companies in health applications.

a case history

Computer feedback sharpens the surgeon's eye

A new computer-assisted feedback system now in development promises to move joint replacement surgery out of the 'hammer and chisel' era and into the age of precision instrumentation.

Every year in North America, thousands of people undergo surgery to replace worn out or painful joints – usually the hip or knee. Long-term viability of the replacement joint depends very much on the surgeon's 'carpenter eye' – his or her ability to align the prosthesis correctly and to cut the natural bone at just the right point. How well the new joint moves and how long it will last depend greatly on precise placement. If it is less than optimal, the prosthesis may loosen or wear out prematurely, necessitating further surgery.

A group of Queen's University researchers, headed by Professor Randy Ellis, and funded by the Information Technology Research Centre (ITRC), is developing a computerized system to guide the surgeon's craft during joint replacement surgery. They are devising the algorithms (building blocks of computer programs) needed to allow an orthopedic specialist to use 3-D images and a 'topographical map' of the patient's joint developed prior to surgery, to correctly align the artificial joint during the procedure. The system will use an apparatus called a 'locating wand' placed over the joint that relays data to a computer holding the blueprint for optimal placement. A complex feedback loop keeps the surgeon on track as the procedure progresses.

In addition to the obvious benefit to patients of improved mobility and durability of replacement joints, the system promises a number of other benefits. It will reduce the need for hospitals to carry large inventories of artificial joints because surgeons will know in advance exactly what is needed, allowing for 'just-in-time' delivery from the manufacturer. Even more significant is the cost saving realized by avoiding repeated surgery due to prosthesis failure – a significant proportion of all joint replacement surgery.

A total knee revision costs society about $25,000, notes Dr. John Rudan, the Kingston surgeon involved in the project. And surgeons are performing total joint replacements in younger and younger people. "If we can improve the longevity of joint replacement from eight to 15 years, we'll see a tremendous improvement in cost-benefit," suggests Rudan.

Skills and education

Each of Ontario's seven Centres of Excellence plays a critical part in bridging the gap between university-based researchers and industry sectors dependent on constant innovation to remain competitive. As a result, the Centres are ideally positioned to identify the learning needs of industry and to suggest how traditional educational institutions may adapt or tailor their programs to help meet industry's needs. In the future, it will be critical for working professionals to keep up with rapidly evolving knowledge – 'life-long learning' – and to have access to new information where and when they need it, often in the workplace. In addition, students will require 'hands-on' skills learned during training and an understanding of the innovation cycle in business. Finally, young entrepreneurs must be mentored. A number of Centres programs are designed specifically to meet one or more of these needs.

Technology transferred on two feet

No make-work projects please. To date, at least 14 student placements have been arranged by the Manufacturing Research Corporation of Ontario's Connections Program. The program, underway at the University of Toronto, exposes final-year engineering students to real design and engineering problems faced by industry, and provides industry with solutions to technical challenges. Students achieve their objective in a six to seven month period, gaining experience in teamwork, problem solving, benchmarking the competition, product development and customer focus – all skills that cannot be taught in a structured, classroom setting.

Mentortech nurtures entrepreneurs

Brainchild of the Ontario Laser and Lightwave Research Centre which piloted the project with 85 students in its first year, the Mentortech Program gives advanced technology students and faculty an opportunity to gain basic entrepreneurial know-how. Mentortech is sponsored by the Ontario Centres of Excellence and the Centre for Management of Technology and Entrepreneurship, and supported by the Royal Bank of Canada; in its second year it will expand to more than 200 students at seven universities. The program stimulates an entrepreneurial culture among technology students at universities by combining technology training with mentoring by successful entrepreneurs. Mentortech sponsors Entrepreneurial Awareness Days, a 'Technepreneur' lecture series and an Enterprise Forum or business plan competition. The Martin Walmsley Fellowship for Technological Entrepreneurship is another Ontario Centres of Excellence initiative.

Software professionals go back to school – at work

The Consortium for Graduate Education in Software Engineering (ConGESE) is a group of corporations and computer science and engineering departments at five Ontario universities (Carleton, Queen's, Toronto, Waterloo and Western Ontario) dedicated to providing software engineering training at the masters degree level to working professionals. It offers a series of courses that no single university could offer on its own and delivers them on company premises. ConGESE has graduated 50 professionals. Corporate partners include Bell-Northern Research and IBM Canada. Companies do not have to be members of the consortium to participate. The Information Technology Research Centre (ITRC) provided administrative support and funding to seed the consortium launch.

Universities link up for space studies pilot

The Interactive Learning Connection (ILC) Program is up and running with its first pilot project – the University Space Network (USN). USN will facilitate the linking of several Ontario universities for effective, collaborative delivery of education in the space sciences and engineering. The project will provide an opportunity to demonstrate the effectiveness of technology-assisted education, giving students at several universities access to a Spacecraft System Design course. USN is the start of a much wider opportunity that makes use of advances in communications tools to support distance learning. Partners in the project include the Institute for Space and Terrestrial Science (ISTS), the Telecommunications Research Institute of Ontario (TRIO), corporations such as COM DEV Ltd., Cambridge, Ontario; MODUS Integrated Media Inc., Markham, Ontario; and Spar Aerospace, Brampton, Ontario; Knowledge Connection Corporation; and eight universities along with two others with observer status.

Every year corporations spend millions of dollars sending employees on training courses and seminars. For many, travel expenses gobble up a large chunk of corporate training budgets, not to mention employees' time spent getting from point A to point B. And while costs are high, quality is uneven and often disappointing.

Knowledge Connection Corporation (KCC), conceived and initiated by the Telecommunications Research Institute of Ontario (TRIO), hopes to change all that. Its mandate is to encourage collaboration among developers of learning software (now called 'learnware'), telecommunications companies, and educators expert in interactive learning techniques, to coalesce Ontario's distance learning capabilities.

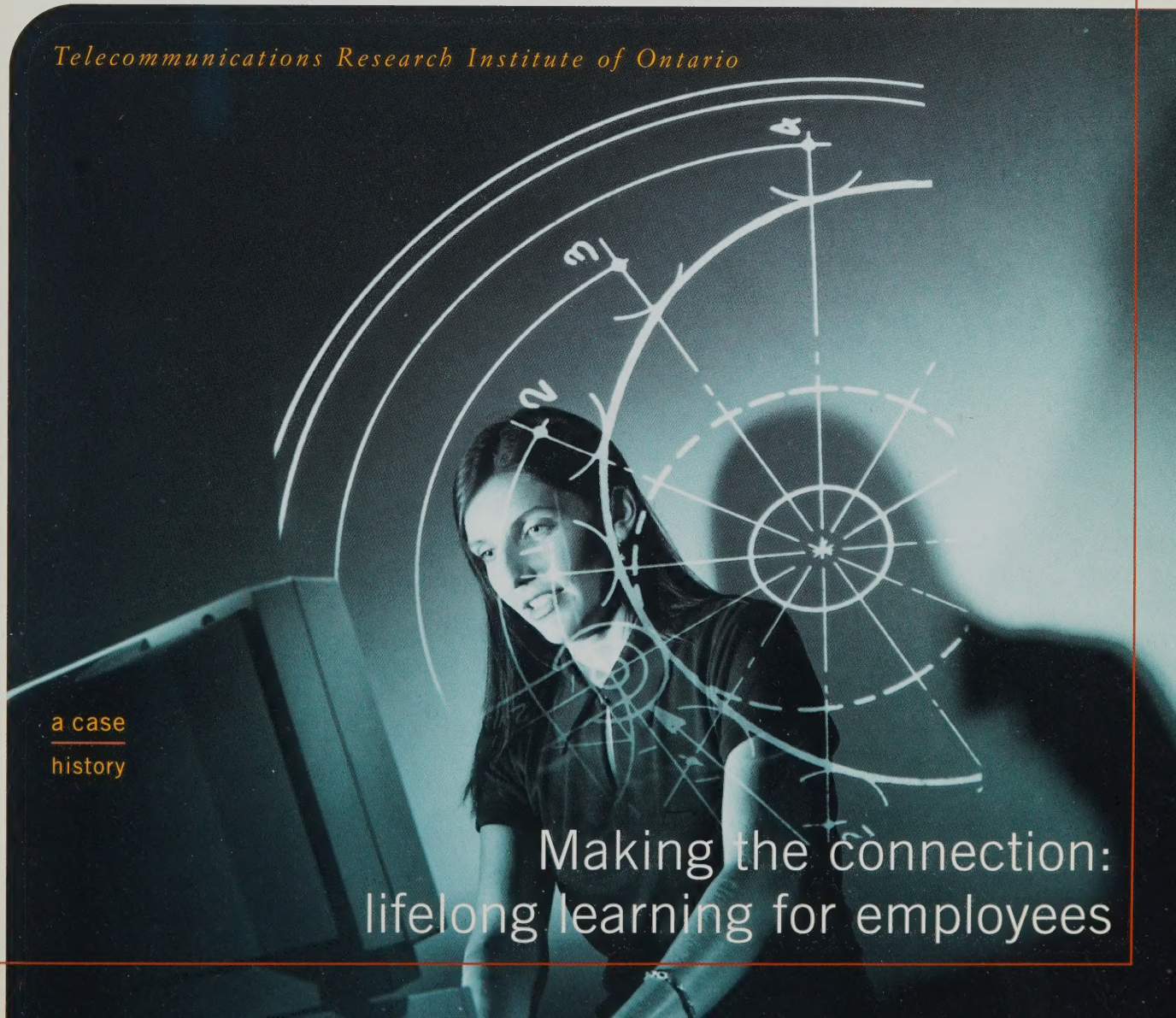
Ontario is well positioned to become a major player in what promises to be a large global market for distance learning products.

The province is home to a technologically advanced and innovative telecommunications sector, in addition to having a strong education system. "There are real opportunities to become a world leader in the distance learning field," says James Rossiter, KCC's executive director.

The term 'distance learning' refers to an eclectic basket of technologies. Simply put, it is the use of multiple media (cable and telephone systems, as well as direct broadcast satellite and computer networks) to deliver educational programs using interactive learnware that incorporates video and audio, animation, graphics, text and virtual reality. Eventually programs will be delivered at employees' desks and portable or laptop computers, in group learning situations and at home. Interactive techniques will also allow people at far flung sites to participate in training programs together.

KCC's industry partners include large and small corporations and educational institutions such as Bell Canada, Bell-Northern Research, Newbridge Networks, Ryerson Polytechnic University, Cancom, and Interactive Image Technologies. Though still in its first year of operation (1995), the enterprise has already completed an inventory of innovative learning and technology initiatives in Ontario. Results will be used to ensure minimal duplication and maximum collaboration of the Corporation's own programs.

The Knowledge Connection Corporation will provide advisory support to collaborative projects and, above all, will evaluate interactive learnware and develop standards. Disseminating information about what works and what doesn't is a central part of its mandate.



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